



The eruption of Arenal, an active volcano in Costa Rica. The lava particles follow a parabolic path due to gravitational force.

Quadratic Functions

General equation: $y = ax^2 + bx + c$, where $a \neq 0$; a , b , and c stand for constants; and the domain is all real numbers

Parent function: $y = x^2$, where the **vertex** is at the origin

Transformed function: $y = k + a(x - h)^2$, called the **vertex form**, with vertex at (h, k) . The value k is the vertical translation, h is the horizontal translation, and a is the vertical dilation. Vertex form can also be written $y - k = a(x - h)^2$, but expressing y explicitly in terms of x makes the equation easier to enter into your grapher.

Graphical properties: The graph is a **parabola** (Greek for “along the path of a ball”), as shown in Figure 2-2b. The graph is concave up if $a > 0$ and concave down if $a < 0$.

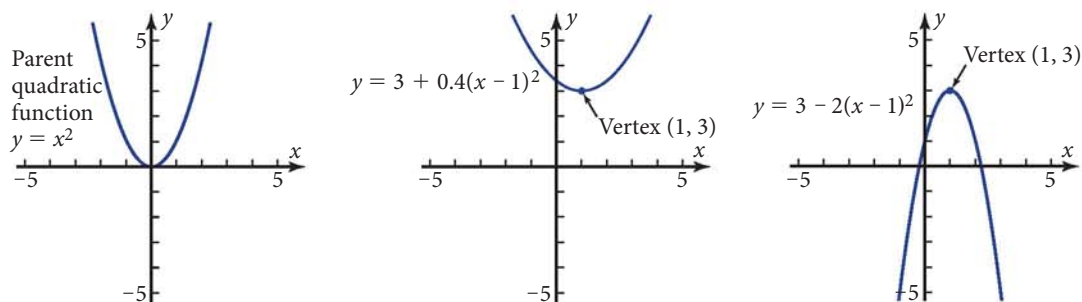


Figure 2-2b: Quadratic functions

Power Functions

General equation: $y = ax^b$, where a and b stand for nonzero constants. If $b > 0$, then the domain can be all real numbers. If $b < 0$, then the domain excludes $x = 0$ to avoid division by zero. If b is not an integer, then the domain usually excludes negative numbers to avoid roots of negative numbers. The domain is also restricted to nonnegative numbers in most applications.

Parent function: $y = x^b$

Verbally: For $y = ax^b$, “if $b > 0$, then y varies directly with the b th power of x , or y is directly proportional to the b th power of x ; if $b < 0$, then y varies inversely with the b th power of x , or y is inversely proportional to the b th power of x .” The dilation factor a is the **proportionality constant**.

Translated function: $y = d + a(x - c)^b$, where c and d are the horizontal and vertical translation, respectively. Compare the translated form with

$$y = y_1 + a(x - x_1) \text{ for linear functions}$$

$$y = k + a(x - h)^2 \text{ for quadratic functions}$$

Unless otherwise stated, “power function” will imply the *untranslated* form, $y = ax^b$.